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Citation for published version:

Turner, AP, Bellhouse, S, Kilduff, LP & Russell, M 2015, 'Postactivation potentiation of sprint acceleration performance using plyometric exercise', *The Journal of Strength and Conditioning Research (JSCR)*, vol. 29, no. 2, pp. 343–350. <https://doi.org/10.1519/JSC.0000000000000647>

Digital Object Identifier (DOI):

[10.1519/JSC.0000000000000647](https://doi.org/10.1519/JSC.0000000000000647)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

The Journal of Strength and Conditioning Research (JSCR)

Publisher Rights Statement:

©Turner, A. P., Bellhouse, S., Kilduff, L. P., & Russell, M. (2015). Postactivation Potentiation of Sprint Acceleration Performance Using Plyometric Exercise. *Journal of Strength and Conditioning Research*, 29(2), 343–350.

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Title: Post-activation potentiation of sprint acceleration performance using plyometric exercise

Running title: Plyometric exercise and sprint acceleration

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Funding: No funding was received to complete this study

**POST-ACTIVATION POTENTIATION OF SPRINT ACCELERATION
PERFORMANCE USING PLYOMETRIC EXERCISE**

ABSTRACT

Post-activation potentiation (PAP), an acute and temporary enhancement of muscular performance resulting from prior muscular contraction, commonly occurs after heavy resistance exercise. However, this method of inducing PAP has limited application to the pre-competition practices (e.g., warm-up) of many athletes. Very few studies have examined the influence of plyometric activity on subsequent performance; therefore, we aimed to examine the influence of alternate-leg bounding on sprint acceleration performance. In a randomized crossover manner, plyometric-trained males ($n=23$) performed seven 20 m sprints (with 10 m splits) at baseline, ~15 s, 2, 4, 8, 12 and 16 min after a walking control (C) or 3 sets of 10 repetitions of alternate-leg bounding using body mass (P) and body mass plus 10% (WP). Mean sprint velocities over 10 and 20 m were similar between trials at baseline. At ~15 s, WP impaired 20 m sprint velocity by $1.4 \pm 2.5\%$ when compared to C ($P = 0.039$). Thereafter, 10 and 20 m sprint velocities improved in WP at 4 (10 m: $2.2 \pm 3.1\%$, $P = 0.009$; 20 m: $2.3 \pm 2.6\%$, $P = 0.001$) and 8 min (10 m: $2.9 \pm 3.6\%$, $P = 0.002$; 20 m: $2.6 \pm 2.8\%$, $P = 0.001$) compared to C. Improved 10 m sprint acceleration performance occurred in P at 4 min ($1.8 \pm 3.3\%$, $P = 0.047$) relative to C. Therefore, sprint acceleration performance is enhanced after plyometric exercise providing adequate recovery is given between these activities; however, the effects may differ according to whether additional load is applied. This finding presents a practical method to enhance the pre-competition practices of athletes.

Key words: Warm-up, jumping, bounding, power, running, unilateral

INTRODUCTION

The ability to develop high levels of muscular power is a fundamental component of many team-based and individual sports that require sprinting. Practices undertaken immediately before exercise (e.g., warm-up) seek to optimize subsequent exercise performance and have primarily focused on elevation of body temperature (9). However, as the ability of a muscle group to produce force can be influenced by the contractile history of that given muscle group (25), modification of the warm-up to include conditioning contractions has been suggested (26). Post-activation potentiation (PAP), an acute and temporary enhancement of muscle performance as a result of its contractile history (34), elicits transient improvements in performance that exceed those attributable to warm-up alone (5,7,8,18,19,25-27,36,38).

The majority of studies examining the PAP phenomenon have employed heavy (75-95% 1 repetition maximum) isotonic resistance exercise as the preload stimulus (7,8,24,25,27) with some authors also supporting the use of maximal isometric conditioning contractions (17,19,28). Although likely to be modulated by a number of factors (e.g., type, volume and intensity of the preload stimulus, recovery period, type of subsequent activity, and subject characteristics; 34,38), the mechanisms of PAP are suggested to relate to an increased sensitivity of the actin-myosin myofilaments to Ca^{2+} (31), enhanced motor neuron recruitment (13), and/or a more favorable central input to the motor neuron (1-3,20-22). Bearing in mind the practical and logistical considerations associated with pre-competition practices, traditional methods of eliciting a PAP response (e.g., heavy isotonic resistance exercise and maximal isometric contractions) may not be feasible prior to competition. Therefore, methods of inducing PAP which require less equipment and/or may be better tolerated by players and coaches on the day of competition are attractive alternatives.

Ballistic activities are associated with the preferential recruitment of type 2 motor units (12), and therefore may be utilized as a PAP stimulus based on the previously proposed mechanisms. In support of this, wearing a weighted vest when performing striding activities has been found to elicit priming effects on subsequent running economy, peak incremental treadmill speed and leg-stiffness in distance runners (6). Similarly, weighted jumps have been shown to increase subsequent jumping performance (10) and the addition of a weighted vest to a dynamic warm-up, containing activities such as jumps, skips and bounds, may also benefit jumping performance (16,32). However, despite previous studies supporting the notion that plyometric exercise performed against loads equal to, and greater than, body mass can positively influence subsequent lower body power output, very few studies have examined the effects of plyometric activity on more functional indices of sporting performance, such as sprinting,

Till and Cooke (33) did not observe improvements in 10 and 20 m sprint performance following 5 tuck jumps; a finding which may be attributed to the lack of specificity of the preload stimulus to the direction (e.g., vertical vs. horizontal) and magnitude of impulses generated during the distinct phases of sprint running. However, Faigenbaum et al. (6) showed that a dynamic warm-up including a variety of vertical and horizontal plyometric exercises, with and without a weighted vest, enhanced jumping performance, but not a 10 yard sprint, in high-school female athletes. Alternate-leg bounding is a plyometric exercise which is biomechanically similar to sprinting which emphasizes horizontal over vertical impulses (4). Therefore, the purpose of this study was to investigate whether horizontal plyometric exercise, performed with and without a weighted vest, potentiates sprint acceleration performance over 10 and 20 m and whether the magnitude of performance enhancement of individuals was related to their baseline performance.

It was hypothesized that plyometric exercises would acutely enhance sprint acceleration performance, relative to a control condition. We also hypothesized that weighted plyometrics would induce greater sprint acceleration enhancements than non-weighted plyometrics, and that the inter-individual magnitude of sprint enhancement would be related to baseline sprint performance.

METHODS

Experimental Approach to the Problem

A randomized and crossover study design was used to compare the effects of plyometric activity (weighted and un-weighted) on 20 m sprint acceleration performance relative to a control condition. In order to control for the possible covariate of eliciting additive effects (either fatiguing or potentiating) from repeated maximal performance efforts performed post-preload stimulus, a full control condition which included the repeated performance tests while omitting a preload stimulus was added to the research design; a factor which remains unknown in previous studies that have compared to a baseline trial alone (e.g. 7,8,25-27,35-37). Therefore, participants completed three experimental trials involving a standardised warm-up and then a baseline 20 m sprint assessment, followed by either a walking control (C) condition or a preload stimulus of 3 sets of 10 plyometric bounds with resistances of body mass only (P condition) or with an additional load of 10% body mass (WP condition; a load previously identified to improve performance following plyometric activity: 10,32). After receiving one of the 3 conditions, in agreement with previous PAP studies (7,8,25-27), sprints were re-tested at ~15s, 2, 4, 8, 12 and 16 minutes to profile both transient fatigue and potentiation effects. The order of conditions for each participant was determined by block randomization using an online randomization tool and participants were informed at the start of each visit which condition they would be exposed to.

Subjects

With university ethical approval and informed consent, 23 males (age: 22 ± 1 years; mass: 82.4 ± 8.7 kg; height: 1.82 ± 0.08 m) volunteered to participate in the study. Participants were recruited on the basis that they were healthy, injury-free and engaged in training programs that

incorporated plyometric training for at least 2 years before the start of the study. Notably, participants had 5 ± 1 years of plyometric training experience, and longer experience of sprint training and testing, although they were not competitive sprinters.

Procedures

Before involvement in the main trials, participants attended a familiarization session whereby anthropometric measurements of height (Seca 225, Seca Ltd, Germany) and body mass (Seca Digital 7052321009, Seca Ltd, Germany) were taken and sprint acceleration performance testing was practiced. Additionally, the same Certified Strength and Conditioning Specialist instructed participants regarding their bounding technique; specifically, highlighting minimization of foot contact time and maximization of horizontal rather than vertical impulses. All participants performed the first experimental trial 48 h after familiarization and no less than 48 h separated all subsequent main trials.

During the experimental trials, participants reported to the laboratory having refrained from alcohol, caffeine and strenuous exercise for 48 h. Following the voiding of bladder and bowels, subjects underwent a standardized warm-up modified from Ebben and Petushek (15) consisting of jogging (~3 min), a series of dynamic stretches emphasizing stretching of the musculature involved in the subsequent sprinting and plyometric activity (~10 min), before progressively increasing the intensity of 20 m sprinting to near-maximal speeds (~5 min). After an active recovery (~2 min), participants completed a baseline sprint, before a further active recovery period (~2 min) preceded the C, P or WP preload stimulus. Thereafter, participants repeated the sprint assessments at the time-points mentioned previously. Participants consumed water *ad libitum* during the trials and a single member of the research team administered all tests such

that the potential variation in test instruction was minimized. All tests were conducted in an indoor training facility that was maintained at an air temperature between 16 and 18 °C.

Interventions

In WP and P, participants performed 3 sets of 10 alternate-leg bounds (5 contacts per leg per set) either with or without a weighted vest (Reebok adjustable weights vest, Reebok, The Netherlands) against applied loads of body mass plus 10% (10,32) and body mass only, respectively. Following a three step run-up, participants were instructed to push off with the left foot, and then via flexion at the hip bring the right leg forwards, so that the thigh was approximately parallel to the ground with the knee flexed to $\sim 90^\circ$ before subsequent extension (4). Upon landing on the right foot, participants were required to immediately repeat this sequence with the alternate foot until 5 contacts were completed on each leg. After a short period of active recovery, whereby participants walked back to the starting position, two further sets were completed (each set of 10 bounds plus recovery lasted ~ 25 s). In C, participants performed a continuous walking control to minimize losses in body temperature relative to WP and P. All interventions were comparable in duration (i.e., ~ 75 s in total).

Measurements

Linear sprint acceleration performance was evaluated over 20 m using infrared timing gates (Brower Timing, Utah) positioned at 0 m (start), 10 m and 20 m (finish) at a height of approximately 0.8 m from the ground using methods similar to Russell and Tooley (29). Participants commenced each sprint following a countdown from the test administrator from a two-point start position at a distance of 0.3 m behind the first timing gate. Participants were instructed to run at maximal effort throughout the full distance of the sprint. To prevent a reduction in sprint speed on approach to the finish, a member of research staff stood on a marker

beyond the final timing gate (1 m) and provided standardised verbal encouragement at the start of each sprint and between 10 m and 20 m. Participants were instructed to maintain maximal effort until passing this member of the research team. Timing started and finished when the beams of the first (0 m) and last (20 m) gates were broken, respectively. On each test day participants performed a single repetition at baseline and then a repetition at ~15s, 2, 4, 8, 12 and 16 minutes following the respective condition for that trial (C, P or WP). Participants were permitted to walk slowly or stand between sprints. Test–retest reliability for our participants, calculated from baseline performances of 10 m and 20 m sprint acceleration across the 3 trials, is presented as intraclass correlation coefficients of 0.89 and 0.90 respectively, and typical error (%) of 3.4 and 2.6% respectively.

Statistical Analyses

Statistical analyses were performed using SPSS software (Version 21; SPSS Inc., Chicago, IL) and data are presented as mean \pm SD. Significance was set at $P \leq 0.05$. Two-way (3 x 7) repeated measures analyses of variance (ANOVA; within-subject factors: condition [C, P, WP] x time [baseline, 15s, 2, 4, 8, 12 and 16 minutes]) were used. Mauchly's test was consulted and Greenhouse–Geisser correction was applied if sphericity was violated. Significant main effects of time were further investigated using pairwise comparisons relative to baseline with conservative Bonferroni confidence-interval adjustment to the alpha level for the 6 comparisons made for each condition. Where significant P-values were identified for interaction effects (condition x time), the effect of condition was analysed by simple main effects. Relationships between sprint improvements and baseline sprint performance were examined using Pearson's product moment correlation coefficients. Correlations were performed between each participant's baseline sprint velocity in the control trial and the change

in 10m and 20m sprint velocity at each time-point in the WP trial relative to C trial (Δ velocity = WP velocity – C velocity).

RESULTS

Average sprint velocities

Ten metre sprint velocities were influenced by condition (time x condition interaction: $F_{(6,130)} = 4.921$, $P \leq 0.001$, $\text{partial-}\eta^2 = 0.183$) and recovery duration (time effect: $F_{(4,83)} = 3.467$, $P = 0.013$, $\text{partial-}\eta^2 = 0.136$). At baseline, sprint velocities were similar between conditions ($P = 0.547$, $\text{partial-}\eta^2 = 0.027$), being $5.58 \pm 0.28 \text{ m}\cdot\text{s}^{-1}$ and there was no significant change in performance for C ($F_{(4,83)} = 1.516$, $P = 0.208$, $\text{partial-}\eta^2 = 0.064$). However, relative to baseline, 10 m sprint velocities were significantly increased during P ($F_{(6,132)} = 3.452$, $P = 0.003$, $\text{partial-}\eta^2 = 0.136$) at 4 min ($+1.6 \pm 2.6\%$, $P = 0.008$) and WP ($F_{(3,75)} = 6.288$, $P \leq 0.001$, $\text{partial-}\eta^2 = 0.222$) at 8 min ($+2.5 \pm 3.6\%$, $P = 0.002$) (Figure 1).

Between-condition effects identified that WP and P sprints were $2.2 \pm 3.1\%$ ($P = 0.009$) and $1.8 \pm 3.3\%$ ($P = 0.047$) faster than C, respectively at 4 min; with both interventions showing similar magnitudes of sprint improvement at this time-point ($P > 0.99$). At 8 min, WP sprint velocities were $2.9 \pm 3.6\%$ ($P = 0.002$) and $2.3 \pm 3.6\%$ ($P = 0.015$) greater than C and P respectively whereas sprint performances for P remained unchanged from C ($P = 0.150$). Sprint velocities were similar between conditions at all other time-points (Figure 1).

***** INSERT FIGURE 1 NEAR HERE *****

Sprint velocities over 20 m were influenced by condition (time x condition interaction: $F_{(6,127)} = 6.537$, $P \leq 0.001$, $\text{partial-}\eta^2 = 0.224$) and recovery duration (time effect: $F_{(3,69)} = 6.878$, $P \leq 0.001$, $\text{partial-}\eta^2 = 0.238$). At baseline, sprint acceleration performance was similar between conditions ($P = 0.860$, $\text{partial-}\eta^2 = 0.007$), being $6.58 \pm 0.23 \text{ m}\cdot\text{s}^{-1}$ and there was no

significant change in performance for C ($F_{(6,132)} = 0.952$, $P = 0.460$, $\text{partial-}\eta^2 = 0.041$) However, relative to baseline, 20 m sprint velocities were significantly increased during P ($F_{(3,76)} = 3.130$, $P = 0.025$, $\text{partial-}\eta^2 = 0.125$) at 4 min ($+1.4 \pm 2.3\%$, $P = 0.007$) and throughout WP ($F_{(3,71)} = 11.128$, $P \leq 0.001$, $\text{partial-}\eta^2 = 0.336$) at both the 4 ($+2.3 \pm 2.3\%$, $P \leq 0.001$) and 8 min ($+2.5 \pm 2.8\%$, $P \leq 0.001$) time-points (Figure 2).

Between-condition effects identified that immediately post-intervention, sprint performance reduced by $1.4 \pm 2.5\%$ for WP when compared to C ($P = 0.039$). At both the 4 and 8 min time-points, sprint velocities in WP were faster compared to P (4 min: $+1.1 \pm 1.9\%$, $P = 0.046$; 8 min: $+1.8 \pm 2.3\%$, $P = 0.002$) and C (4 min: $+2.3 \pm 2.6\%$, $P = 0.001$; 8 min: $+2.6 \pm 2.8\%$, $P = 0.001$, respectively). Sprint velocities were similar between conditions at all other time-points (Figure 2).

***** *INSERT FIGURE 2 NEAR HERE* *****

Additional analyses

Significant positive correlations were observed between sprint velocity and Δ velocity following potentiation at 8 and 12 min (Table 1). Conversely, significant negative correlations existed between sprint velocity and Δ velocity following potentiation at ~ 15 s in 20 m sprint acceleration performance.

***** *INSERT TABLE 1 NEAR HERE* *****

DISCUSSION

In support of our original hypotheses we have demonstrated that plyometric exercise, performed using body mass (P) and body mass plus 10% (WP), potentiated subsequent sprint acceleration performance. Compared to the control trial (C), we demonstrated improved average 10 and 20 m sprint velocities in P at 4 min and WP at 4 and 8 min following the preload stimulus. Furthermore, compared to respective baseline sprints, 10 m performance was improved in P and WP at 4 min and 8 min respectively, and 20 m performance was improved in P and WP at 4 min as well as 8 min in WP. Also in support of our hypotheses, WP induced greater enhancement of sprint acceleration performance than P and the magnitude of the increase of sprint velocity in WP was related to the baseline velocity of the participants. It therefore appears that alternate-leg plyometric bounds can induce a PAP response, but the effects may differ according to an individual's initial sprint acceleration performance, recovery time and whether additional load is used during the plyometric exercise.

This study demonstrated that plyometric exercise, specifically alternate-leg bounding, provides an effective method of inducing the PAP effect, compared to a full control condition and also compared to baseline performance within-condition. This is an important finding, as it strengthens the arguments made in previous studies where comparisons were made solely against baseline performance when a control condition wasn't used (e.g. 7,8,25-27,35-37). At least for the 20 m tests (that included a 10 m split) used in this study, repeated tests at multiple time-points do not significantly affect the subsequent performance tests, as there was no main effect of time in C. Considering that two of the significant between-condition comparisons relative to C (increase in 10 m velocity with WP at 4 min and decrease in 20 m velocity with WP immediately post preload stimulus – Figures 1 and 2) were not statistically significant

when within-condition comparisons against baseline were made is most likely a reflection of the conservative Bonferroni adjustment used (i.e., 6 comparisons between 7 time-points). Indeed as would be expected, without this adjustment there was a perfect match in the PAP effects observed regardless of whether comparisons were made against baseline (within-condition) or C (between-condition); although we retained the adjustment to reduce the likelihood of Type I errors.

The augmentation of power production through the use of different PAP protocols has been well documented (5,7,8,17,19,36,38). However, the utilization of heavy loading protocols has previously been suggested as a limitation of previous PAP research (37) due to the logistical and safety considerations of using such exercises immediately before competition. The incorporation of a plyometric exercise (e.g. alternate-leg plyometric bounding with or without a weighted vest) into an athlete's warm-up is a far more practical approach and one which we demonstrate as being efficacious in improving sprint acceleration performance in trained participants. That the preload stimulus does not need to be of very heavy loading is also in support of the recent meta-analysis of Wilson et al. (38).

The mechanisms underpinning the potentiation effect elicited by the WP and P preload stimuli are unclear due to the lack of electromyography recordings in this study. However, PAP effects have been attributed to the maximal activation of involved musculature. Prior research has demonstrated that PAP can be induced using maximal isometric contractions (17,19,28), heavy resistance exercises, such as the back squat and bench press (7,8,25,26), and plyometric activities (35). Speculatively, it seems that the maximal activation of the musculature is the key component in inducing PAP. The explosive nature of the bounds, which is associated with the

preferential recruitment of the type II motor units (12), could be important for inducing PAP, based on the previously proposed mechanisms (20,21).

From studies where a heavy resistance exercise has been used to induce PAP, explosive lower body power production is consistently compromised immediately after the preload stimulus (8,25,27); however, conjecture exists regarding the time course of responses when plyometrics are the mode of conditioning exercise. For example, the application of the 10% body mass load in WP significantly impaired performance immediately after the preload stimulus compared to C (Figure 2), whereas such effects were absent in P at the same time-point. This data contradicts that of Tobin and Delahunt (35) who observed a 4.8% improvement in average countermovement jump height achieved within one minute of performing a 40 jump plyometric protocol which included ankle and hurdle hops and drop jumps. As the intensity of the WP trial would have been greater than the P trial, it is plausible that the addition of the weighted vest caused participants to experience a greater degree of transient fatigue, likely due to depletion of phosphocreatine stores, and this contributed to the differences in response observed at ~15 s. Interestingly, Table 1 shows that there was a negative correlation between individuals' baseline 20 m sprint and the size of this immediate decrement in performance, suggesting that the faster participants were more affected by the WP stimulus.

At 4 min, improvements in 10 m sprint velocity were comparable between WP and P at ~2% relative to the same time-point in C. Although meaningful, this improvement is slightly less than demonstrated in previous research utilizing heavy-load resistance exercise as a preload stimulus (7,8,27), but not out with the range reported in the meta-analysis (38). Following a single set of back squats at 91% 1 repetition-maximum, Bevan et al. (7) identified an ~8% improvement in 10 m peak-potentiated sprinting performance in professional rugby players.

Although speculative, differences in the training history of the participants used in both studies, and the likely differences between participants in type 2 fibre content which modulates the PAP effect (19,20,34,38), may explain some of these differences. Nevertheless, alternate-leg bounds can be used as a method of inducing PAP; an important finding given the scope for practical application within the sporting environment.

The pattern of response differed according to the loading condition (P vs. WP); specifically, following adequate recovery, WP significantly improved 20 m sprinting performance compared to P and C, as well as baseline, at 4 and 8 min post-stimulus. As sprinting consists of three distinct phases, being the initial starting, acceleration, and maximal speed phases (11), the efficacy of an intervention may differ in relation to the phase of sprinting being examined (39). The initial acceleration phases of sprinting require maximized horizontal impulses while minimizing vertical impulse generation (23). Consequently, the specificity of the plyometric exercise used in our study, which also required maximization of horizontal impulse, is likely to contribute to the explanation of the improvements in sprint acceleration performance. We also speculate that the longer ground contact times elicited in WP had greater specificity to the biomechanical characteristics of sprint acceleration compared to either P or C, and thus may explain the inter-trial differences observed.

In support of previous studies, an individualized PAP effect was observed between participants. For example, in the WP trial the majority of participants (~52%) performed their fastest 20 m sprint at 8 min; a finding which replicates those previously found when sprinting has been assessed (7) and within the optimum range for trained participants in the meta-analysis (38). Gullich and Schmidtbleicher (19) reported the greatest increase in H-reflex activity (32%) after

8.7 ± 3.6 min of recovery following a preload stimulus which led to a significant enhancement of explosive force production in plantar flexions at this time.

Importantly, in the current study the observed increase in sprint velocity in WP was significantly related to the study participants' baseline velocity in the C trial, showing that the fastest participants showed a greater performance enhancement. Although we are not aware of any other studies that have correlated sprinting ability to subsequent increases in sprint performance, such findings are in agreement with Duthie et al. (14) and Bevan et al. (8) who report significant relationships (Pearson R values) between the strength of the participant and subsequent increases in power production, due to PAP. Notably, speed and strength have been correlated (30), therefore it is plausible that the faster participants in this study were also stronger and thus the relationship observed between baseline speed and improved sprint performance was indirectly representative of PAP and strength. To our knowledge, the exact mechanism(s) by which an individual's speed can moderate one's ability to develop and utilize PAP has not been established. However, it has been demonstrated that resistance-trained (and potentially stronger) athletes possess a greater ability to activate their available musculature, especially the larger high-force type-II motor units, which would affect the H-reflex and myosin regulatory light chain phosphorylation, these being key mechanisms behind the PAP phenomenon (1,2).

In conclusion, this study has shown that the utilization of alternate-leg plyometric bounding provides an effective strategy for acutely improving sprint acceleration performance and thus inducing the PAP effect. Moreover, the effects of this strategy appear to be enhanced by using a weighted vest when performing the exercise.

PRACTICAL APPLICATIONS

The data from this study suggests that plyometric exercise, specifically three sets of 10 alternate-leg bounds performed against a resistance of 10% body mass applied using a weighted vest, is capable of inducing a PAP effect in 20 m sprint acceleration performance providing sufficient recovery is allowed. This research suggests that most athletes achieve optimum enhancement 8 minutes following the plyometric exercise. Additionally, if seeking to improve 10 m sprint acceleration performance, an un-weighted variant of the same plyometric exercise is also able to elicit a PAP response. These methods of inducing PAP are more practically feasible for use during the pre-competition warm-up when compared to the use of a heavy preload stimulus. Moreover, faster participants appear to benefit more from incorporating PAP into their warm-up compared to less fast participants.

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ACKNOWLEDGEMENTS

No conflicts of interest to declare

FIGURE LEGENDS

Figure 1: Mean \pm SD 10 m sprint velocities; * represents significant difference from Control trial at the same time-point; t represents significant difference from Plyometric trial at the same time-point; a represents significant within-condition difference from baseline

Figure 2: Mean \pm SD 20 m sprint velocities; * represents significant difference from Control trial at the same time-point; t represents significant difference from Plyometric trial at the same time-point; a represents significant within-condition difference from baseline

Figure 1

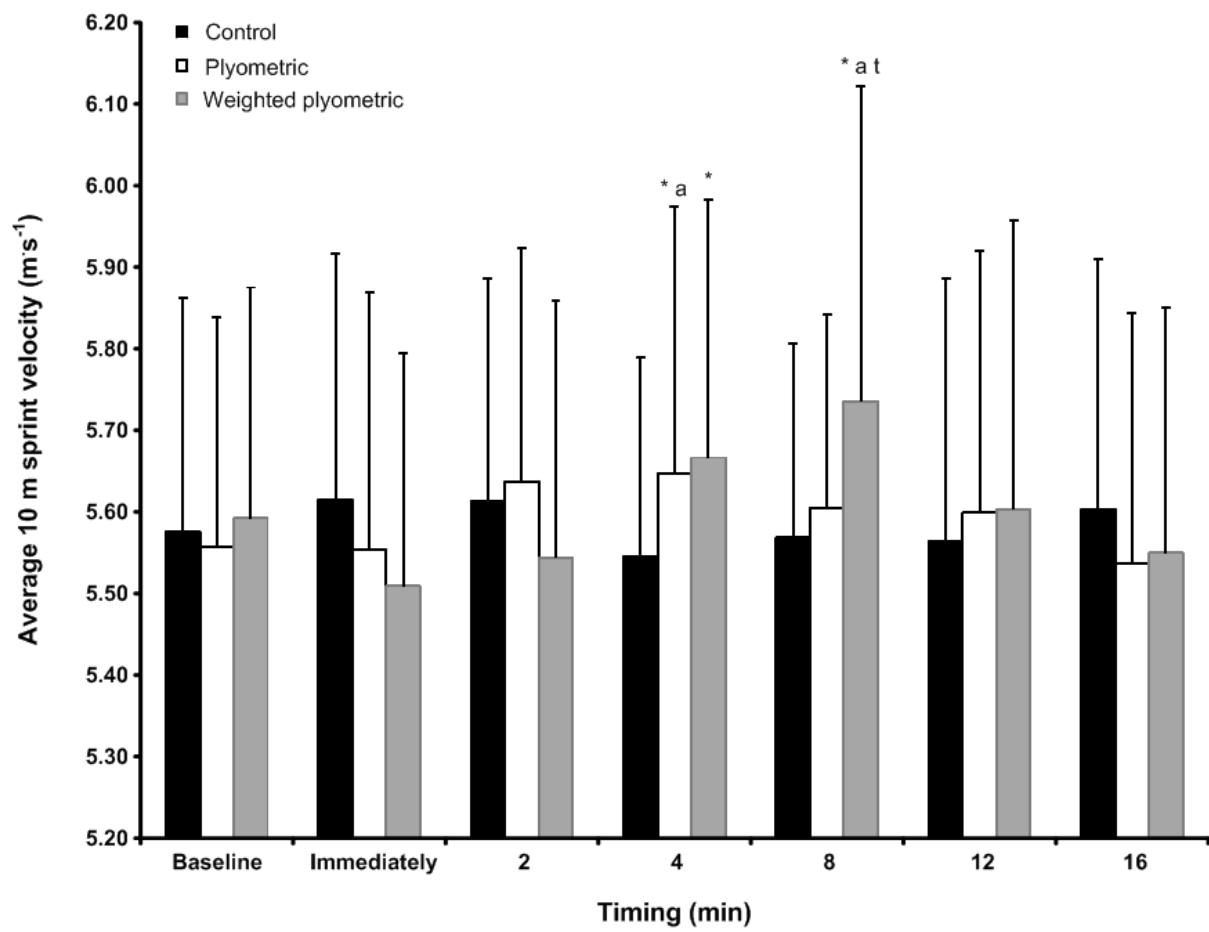


Figure 2

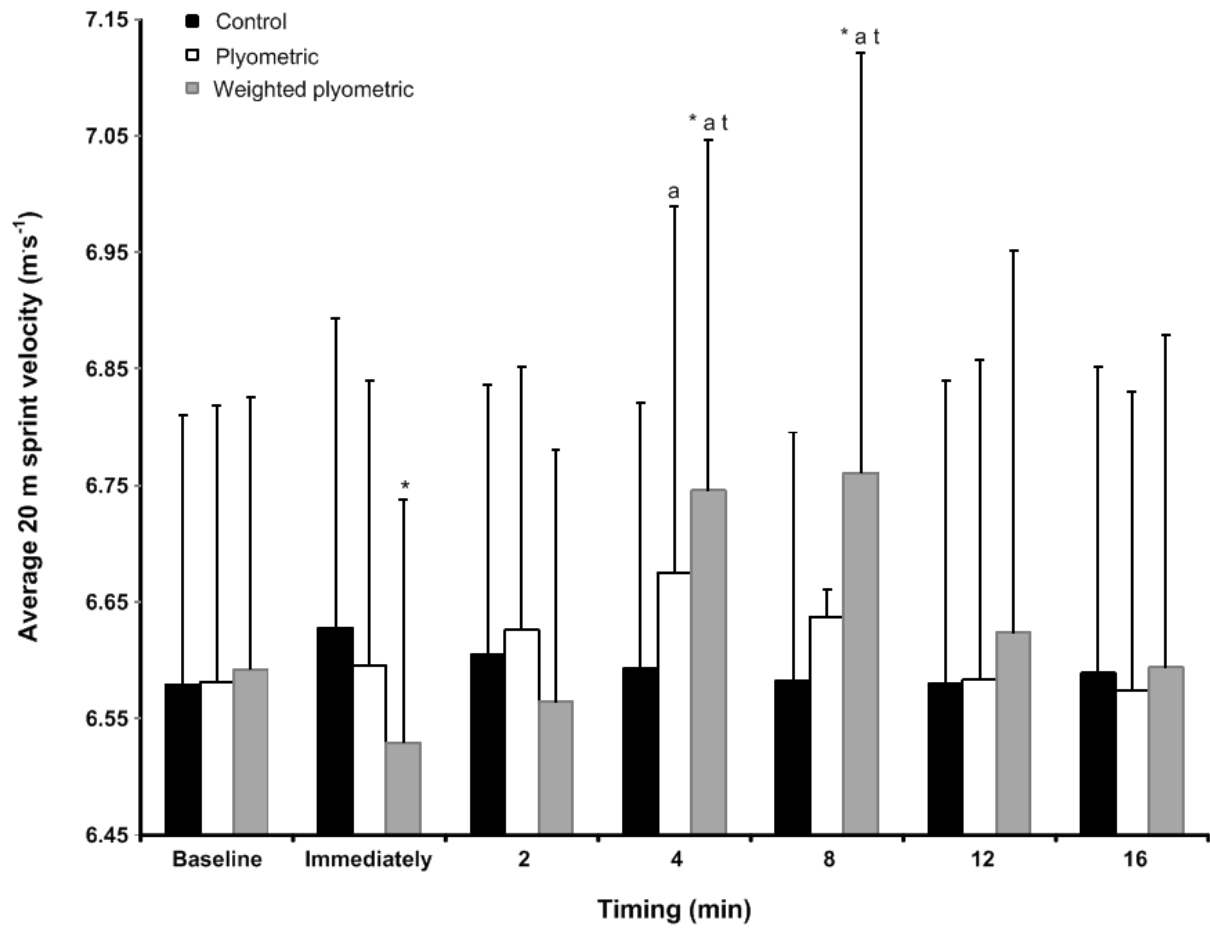


Table 1: Pearson product-moment correlation coefficients between sprint velocity (i.e., baseline sprint velocity in C) and Δ velocity following potentiation (i.e., difference between WP and C trials at comparable time-points) for 10 and 20 m sprints

	Δ Baseline	$\Delta \sim 15$ s	Δ 2 min	Δ 4 min	Δ 8 min	Δ 12 min	Δ 16 min
Baseline (10-m)	-0.323	-0.327	-0.171	0.410	0.507*	0.129	-0.244
Baseline (20-m)	-0.260	-0.501*	-0.330	0.185	0.584**	0.534**	0.028

* Significant at $P \leq 0.05$ level; ** Significant at $P < 0.01$ level